Veg team notes, February 3, 2015

Participants, affiliations, and specialties:

- Gina Darren (DWR, terrestrial botany background, now BDCP),
- Louise Conrad (DWR, fisheries, fish-vegetation associations)
- Anitra Pawley (DWR, limnology and remote sensing background, now working on restoring tidal wetlands
- Gene Witzman – (DWR, wetland delineation)
- Dan Burrister? (CDFW, Botany),
- Dave Contreras, Stacy Sherman, Rosemary Hartman, and Alice Low, (CDFW, tidal restoration monitoring)
- Hildie Spautz (CDFW, bird/vegetation associations, phone)
- Susan Ustin, Shuti Kenna (UCD, remote sensing and botany background)
- Chris Potter – (NASA, remote sensing of invasive aquatic weeds in the delta)

Previous remote sensing of veg in the Delta: Susan did remote sensing of veg in the delta 2004-2009, with a new wave of sensing sponsored by CDFW starting this past November. Now they are trying to separate species more with remote sensing. Report should be out this spring. Previous flights were always in June, but there were a few flights in November and October.

Stacy gives overview of the IEP Tidal Wetlands Project Workteam. The group is tasked with developing a generalized monitoring plan of the restoration projects in the Delta and Suisun Marsh being built for the benefit of Salmon and Smelt. Hope to develop a plan that can be used by any project proponent, maintaining data comparability.

Overview of Conceptual Models from Rosemary and Louise.

Comments on models:

We really didn't separate "desirable" from "undesirable" veg types in the conceptual models because we don't know enough about benefits of native versus non-native species of veg. This would be a great topic for further research. We didn't even make sub-models for different types of veg because Louise didn't think it would significantly change the monitoring program, though making these models could help identify uncertainties and places where we need special studies. Ideally we would learn the benefits and detriments of all the vegetation species.

However, it is important to remember that boating and waterways will spray herbicides on vegetation they consider "undesirable" whether we want them to or not. Also, some species may have a disproportionate effect, for example, water hyacinth decomposes very fast and can cause low DO.

We should do a thorough literature review before developing sub-models or deciding on special studies. If anyone has relevant papers to share, please send them out to the group.

We didn't separate the "landscape" tier (estuary-wide scale) from the "local" tier (area immediately adjacent to the wetland) in the veg model, but it might be useful in terms of thinking where colonists are most likely to come from.

We have lumped all the stages of vegetation establishment into the "colonization" box, but there are actually three phases: arrive, survive, thrive. What are the challenges at each phase of establishment? We should put this on the list of things to think about later.

Discussion of hypotheses:

H7.1. Are we considering planting or just natural colonization? We should remember we are doing a monitoring plan, not a restoration plan. The planning has already been done, but we may want a hypothesis about plant establishment if do have planting. Change hypothesis to say "passive colonization" to differentiate it from planting.

The distance the propagule has to travel will affect probability of colonization, as will the mode of propagation and the species of plant. Timing will also be important since biomass and flowering is highly seasonal. We should do a lit review on major species and mode of propagation.

New Hypothesis: The species that colonizes first may preclude other colonizers.

New Hypothesis: Long distance dispersal will be less likely to establish than close sites. However, it is important to remember that boats move so much stuff around colonists will probably get there eventually no matter how far away they are.

Metrics/methods: To test this hypothesis, we would want to map the big patches of the invasives across the delta to see which will be most likely to enter the area. Remote sensing of the broader landscape would be great. Susan's group has a resolution of 2.5x2.5 meters. They can get species (or at least genus) for FAV and EAV, SAV is harder. They have only done it with hyperspectral data, not just regular photos. But even (cheaper) multispectral data will tell you where the vegetation is, and then you can do species composition on the ground. *We should ask them for cost estimates of these at some point.

Groundtruthing: Check species composition at semi-random or systematic locations, with transects or points. This will only be in places large enough to pick up on the remote-sensing map. Doing truly random samples usually takes much longer, systematic sampling is faster so you can take much more samples.

You should do at least one, ideally two pre-project surveys based on when you expect maximum extent of vegetation, which may be different for different vegetation types. This should continue twice per year for the first few years, maybe reduce to once per year afterwards.

H7.2 Bathymetry will be important even for FAV because it affects flow. Velocity and bathymetry and inundation regime are so closely connected we should lump these hypotheses, but FAV can occur in deep water if flow is very low, while SAV and EAV cannot. We should eventually put in the depth and velocity ranges that different plants will grow in.

It would really help if the hydrologic model would be combined with the maps of vegetation. You could even develop an ecological niche model for the species. We will have this level of detail for the individual sites, though not at the scale of the entire Delta.

H7.3 In Hestir's dissertation she had velocity thresholds for SAV. Marsh channels will probably have low enough velocities that SAV will go over the whole thing.

H7.4 Soils: Are organic matter and compaction important for aquatic plants? Liberty island has mineral soils, high turbidity, not a lot of veg establishment. Susan says depth of flooding is more important than soil type. Unconsolidated soils, especially lower in the tidal range, may prevent establishment, but once you have establishment the roots hold it all together. Higher elevations it isn't as much of a problem. Rhizome growth will probably help propagation in loose soils. This should be a special study, not regular monitoring.

Methods: Soil maps often accompany restoration plans. The fish and physical subteams want to do rough soil composition (%fines, %gravel, etc). This should only be done in conjunction with plant sampling when triggered by special questions about plants. Certainly don't want to do it over the whole site. We should do some more lit review on this.

H7.5 Light availability/turbidity. We know a lot more about this. This hypothesis could be either under colonization or under growth. Different SAV species have different light tolerances. Egeria is facultative C4, so does better with low light than a lot of the natives. Light's effect on growth depends on species. Maria Santos 2011 New PHytologist. Susan will send some references.

Sidenote on design: You could couple planting of vegetation with hydrodynamic modeling – deal with high velocity areas by slowing it down with vegetation so you don't have striped bass scour holes!

H7.6 Seasonality. WE aren't really sure when we will have the highest growth… Egeria peaks in the spring and the fall. Hyacinth peaks in the fall. There are species-level differences in biomass peaks, but most die back when it gets cold. Some need a real frost to die back. Hyacinth can even survive temporary frosts if the roots don't freeze solid. Egeria and Hyacinth are very sensitive to salinity. Kathy Boyer's lab has seen Egeria replaced by Stukenia as X2 has moved east.

H7.7 We will leave most of the foodweb hypotheses to the foodweb and fish groups. However, we should collect/identify vegetation at the same time as the food web sampling. Rake samples for SAV, stem counts for EAV. We should also co-locate as many metrics as possible. Veg mapping should identify places for rakes samples and invert samples.

We might want H7.10 about AV consumers, because we don't have that in the food web group.

H7.11. Change "residence time" to "velocity". We can test this by mapping the veg and measuring velocity with ADCP or point velocity meters. This might end up as a special study.

H7.12. Temperature and shade: Shade from EAV or FAV may stop other plants from establishing beneath them. EAV will also shade some of the water in the channel. If SAV comes to the surface it will shade too. However, slower water would be warmer. So it's complicated. You should measure temperature along with velocity if you are doing a detailed study on microhabitat under plant canopies.

H7.13 DO: SAV and FAV might have reduced DO, especially at night. This has been proven for Egeria and hyacinth. Aerenchyma in EAV might actually increase DO, but most EAV dies back every year, meaning there is lots of rotting detritus in the water that would decrease DO. All of this would be seasonal.

H7.14 Turbidity: Lots of papers on this. Hestir 2014? This won't be true in areas with very high turbidity, but may have localized effect where it is growing and/or areas where the velocity is pretty slow or clarity is already relatively high. This would be tested along with temperature and velocity under plant canopies, probably special study

H7.15 sediment accretion: FAV does influence sediment accretion by reducing velocity, though maybe not as much as SAV or FAV. Sometimes SAV comes in after FAV has been taken out even if it wasn't there historically because of facilitation.

H3.1.1 Succession of these sites over time. In general habitat complexity is expected to go up over time even if species composition decreases. However, historic accounts describe large expanses of tules without heterogeneity. How does this affect fish habitat? We might be able to measure some of this with CRAM metrics.

Side note about algae: Can tell microcystis from green algae via remote sensing. Green algae tends to cluster around vegetation, especially SAV, which affects invertebrates too. Difficult to separate it out, especially in the images since green algae has the same pigments as plants. Remote sensing of chlorophyll from Chris Potter's lab. Anitra will find out.

Sidenote on Drones: You can fly below 400 ft, on your own land, but DWR probably won't let us use them since they won't even let us get tablets for data collection. If we could get them they seem pretty easy to use. You can specify flight path and height and stuff, and they usually have a failsafe on them so the drone can't leave the area. Now companies make mini spectrometers that you can put on drones. Susan says she's seen them used for water samples too! Even with the regular camera you could see where all the veg is, even if you can't see what it is. TNC is doing this for cranes.

Interesting side notes about FAV: Water primrose is the dominant FAV in the North Delta, not hyacinth any more. If primrose is likely to invade, maybe you should plant more plants you like. Too much FAV will push the system into an alternate stable state. Primrose is aggressive on climbing on to emergent vegetation and might be driving out the emergent (maybe, not published, but pretty scary). There is a native water primrose out there, but no one seems to know whether we still have any around. It's probably all invasive right now. Water hyacinth is the only truly floating (primrose does have roots down there). It is very sensitive to velocity. It is hard to tell the the density of SAV via remote sensing since the mat does not always get to the surface (Not for all species).